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1. Untranslatable words are replaced with asterisks (****).
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CLAIM + DETAILED DESCRIPTION

[Claim(s)]

[Claim 1] Composition of the following [an oxide standard] 263.0-67.5mol of SiO(s)% 2O39.5-12.0mol of aluminum%, 2O8.5-15.5mol of Na% K 2O2.5-4.0mol %, 3.0-9.0mol of MgO(s)% sigma 0-2.5mol of CaO+SrO+BaO+ZnO%, 20.5-1.5mol of TiO(s)% 20.02-0.5mol of CeO(s)%, 2O30.02-0.35mol of As(es)% 20-1.0mol of SnO(s)% F 20.05-2.6mol % -- however -- SiO₂ / aluminum₂ O35.3 - 6.85 Na₂ O/K₂ O 3.0-5.6 aluminum₂ O₃ / K₂ O 2.8-3.6, aluminum₂ O₃ /(TiO₂+CeO₂) Aluminosilicate glass in which chemical strengthening with small total and size of air bubbles which are characterized by having 7.6-18.5 is possible.

[Claim 2] 0.05-0.7mol% of F₂ Glass according to claim 1 characterized by containing.

[Claim 3] Glass according to claim 1 or 2 with which the total quantity of CaO, SrO, BaO, and ZnO is characterized by 0.1-2.5mol being %.

[Claim 4] Composition of the following [an oxide standard] 263.0-67.5mol of SiO(s)% 2O39.5-12.0mol of aluminum%, 2O8.5-15.5mol of Na% K 2O2.5-4.0mol %, 3.0-9.0mol of MgO(s)% sigma 0-2.5mol of CaO+SrO+BaO+ZnO%, 20.5-1.5mol of TiO(s)% 20.02-0.5mol of CeO(s)%, 20.02-1.0mol of SnO(s)% F 2> 0.5-2.6mol %, however -- SiO₂ / aluminum₂ O35.3 - 6.85 Na₂ O/K₂ O3.0-5.6 aluminum₂ O₃ / K₂ O2.8 - 3.6 aluminum₂ O₃ /(TiO₂+CeO₂) it is characterized by having 7.6-18.5 -- Aluminosilicate glass in which chemical strengthening with small total and size of air bubbles which can manufacture with float glass equipment is possible.

[Claim 5] Glass according to claim 4 with which the total quantity of CaO, SrO, BaO, and ZnO is characterized by 0.1-2.5mol being %.

[Claim 6] The activity for manufacture of the tempered glass board for hard disks of glass given in any 1 term of Claims 1-3.

[Claim 7] The activity for manufacture of consolidation safety glass of glass given in any 1 term of said Claims 1-5.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the aluminosilicate glass in which chemical strengthening (or chemical reserve stress grant) with small total and size of air bubbles is possible. Such glass fits the activity as the base glass for Information Storage Division, and a safety glass plate or mold goods especially.

[0002]

[Description of the Prior Art] this kind of glass is expensive after processing and chemical strengthening treatment (or chemical reserve stress grant processing) -- chemical, mechanical, and thermal load must be able to be borne. For example, in inside, a more nearly subsequent finisher is heated by high temperature between coating at the time of manufacture of the magnetism as a data-hold medium, and an optical hard disk, and base glass is cooled after that for a short time. The big mechanical load also at the time of the activity as a hard disk is applied, and such load is 300Ns/mm² in rotational speed at 3,500-10,000rpm and the bolting stress to the axis of rotation, for example. It becomes. A safety glass plate is at least 50Ns/mm² in a frame or doors. It is bound tight by pressure. These are DIN when destroyed mechanically. It must be destroyed in pieces so that it may be specified to 1249 and PERT 12. A lamp cover and an electric bulb are exposed to the big temperature gradient ($\Delta T > 200$ degrees C) between glass, a frame, or an electrode holder, and produce a hot spot (it is the point that temperature is high, more nearly locally than the circumference) on the surface.

[0003] Especially the thin glass that has thickness of 0.25-3.0mm can bear such load, only when consolidation processing is carried out chemically. Since 3mm or more in thickness is needed at the lowest in order to increase mechanical intensity by heat consolidation (thermal reserve stress grant), chemical strengthening by the ion exchange in the inside of a salt bath serves as a choice here. In chemical strengthening of a under from the glass transition point T_g , alkali metal ion with a small ion diameter in glass is replaced by alkali metal ion with a big ion diameter in a salt bath, for example, it is Li^+ . Na^+ Na^+ K^+ It is replaced. As a result, a compressive stress band with a thickness [equivalent to the abbreviation $2/3$ of the ion exchange depth] of about 14-230 micrometers is formed, and it is 350-900Ns/mm². Bending strength is attained.

[0004] Other important factors for the above mentioned use are the quality of the glass about the number and size of a defect of a solid inclusion, a blister, etc. if it is hard to defecate aluminosilicate glass, therefore there are as much as possible few air bubbles and the size moreover is not small as much as possible -- ****
-- ** -- it is known that it is not quality about the point to say. In a glass productive process, two sorts of air bubbles which size differs and have the size distribution function not overlapping arise. The maximum cell diameter in two classes is the former, and are 50 micrometers and 500 micrometers about the aluminosilicate glass defecated according to the conventional method.

[0005] In safety glass manufacture, all the air bubbles that can be recognized with the naked eye, i.e., air bubbles $\phi \geq 80$ micrometers in diameter, are blocked. For this reason, in quality control, only the glass

plate which contains only such at most one air bubbles per 1l. of vitreous humour products is permitted. This and hindrance [as opposed to / be / by contrast / remarkably small namely, / this use in the air bubbles below about 50 micrometers] do not become. This is not applied to the use as substrates ground with high precision, such as the substrate for coating products, for example, a hard disk substrate etc. In this case, in many cases, even the small air bubbles or small solid inclusion which have a diameter of 2-15 micrometers or less are not comparatively permitted as well as big air bubbles not existing. Because, when they are in a substrate surface part and are ground, the concave hole equivalent to the diameter is produced, and surface smoothness is lost by it and it becomes unsuitable to a desired use by it. If density of D, air bubbles, and an inclusion is set to N for the uniform diameter of air bubbles or a solid inclusion with the glass substrate of the given thickness so that it can guide easily when the probability that air bubbles exist in one of the two surfaces correctly is high in comparison, The probability W that the defect produced by air bubbles or a solid inclusion exists in one of on the two surface of a substrate of size F is given by $W=2xDxFxN$. For example, N= 2,500 of the air bubbles per 1l. of vitreous humour products, and a solid inclusion, D= 10 micrometers, F= 30cm² If it carries out, the probability W of 0.15 will be acquired. Therefore, when the number of the air bubbles of the above small size is too large again, the output yield decreases remarkably and becomes 0.85 time in the above-mentioned example computation. This means that one defective board is generated for every about seven substrates.

[0006] The point which is inferior to defecation in aluminosilicate glass can improve by making Li₂ O contain by the content within a certain end other than Na₂ O in glass. By this, the viscosity of glass decreases during homogenization processing and outgassing is promoted. Such glass is the German patent application disclosure gazette DE. 42 06 It is indicated to 268A1. However, if Li ion exists in glass, it will become difficult to attain high compressive stress in process of chemical strengthening by ion exchange. The ion exchange [this / Li⁺] of two types, i.e., it is, Na⁺ The substitution to depend and Na⁺ K⁺ It is because the substitution to depend will arise and it is usually necessary to observe the specific mixing ratio and the specific narrow temperature span of Na salt and K salt in process of ion exchange. It becomes glass which brings a result which produces whether stress is merely slight by this, or is not produced at all, or does not have the resistance over stress relaxation at all. The driving force of the stress relaxation in chemically strengthened glass is a concentration gradient. The fluoride in glass forms the anion network structure of glass with oxygen ion, and big ion can also be easily diffused in such network structure. This will promote abatement of stress. Therefore, the glass which contains a fluoride by comparatively high content does not fit chemical strengthening.

[0007] Therefore, the purpose of this invention is while chemical strengthening is possible, having high bending strength after a consolidation and stress relaxation's being low, It is in finding out the aluminosilicate glass which can be used the best for a use of the glass substrate for Information Storage Division, safety glass, etc. which has high quality about the number and size of air bubbles, therefore was described above.

[0008]

[Means for Solving the Problem] According to [in order to attain the above-mentioned purpose] this

invention, they are the following composition at an oxide standard. 263.0-67.5mol of SiO(s)%, 2039.5-12.0mol of aluminum% 208.5-15.5mol of Na%, K 202.5-4.0mol % 3.0-9.0mol of MgO(s)%, sigma 0-2.5mol of CaO+SrO+BaO+ZnO% 20.5-1.5mol of TiO(s)%, 20.02-0.5mol of CeO(s)% 2030.02-0.35mol of As(es)% 20-1.0mol of SnO(s)% F 20.05-2.6mol % -- however -- SiO₂ / aluminum₂ O₃ 5.3 - 6.85 Na₂ O/K₂ O 3.0-5.6 aluminum₂ O₃ / K₂ O 2.8-3.6, aluminum₂ O₃ /(TiO₂+CeO₂) The aluminosilicate glass in which chemical strengthening with small total and size of air bubbles which are characterized by having 7.6-18.5 is possible is offered. The above-mentioned glass can be used especially conveniently for manufacture of the tempered glass board for hard disks. Furthermore, according to this invention, an arsenic free aluminosilicate glass is also offered. This glass is characterized by having the same composition and same ratio as said glass except containing SnO₂ 0.02-1.0mol %, and F 2 > 0.5-2.6mol % in instead of [which does not contain an arsenic oxide]. It can manufacture with float glass equipment and the aluminosilicate glass in which chemical strengthening with small total and size of air bubbles is possible is offered by this. Moreover, the glass of above this inventions can be used conveniently for manufacture of consolidation safety glass.

[0009]

[Embodiment of the Invention] With the aluminosilicate glass of this invention, it is SiO₂. The content must not exceed 67.5mol % and this is because a melting point will go up superfluously if this content is exceeded. On the other hand, it is SiO₂. Even if a content becomes less than [63.0 mol %], it does not become, but this is because chemical resistance is spoiled remarkably under in this content. aluminum₂ O₃ since it is the same A content must not exceed 12.0mol %, either and must not be less than [9.5 mol %], either. It is SiO₂ in order to secure the both sides of good acid resistance and good ion exchange nature. aluminum₂ O₃ It is necessary to exist by the ratio which balance was able to take mutually. Namely, SiO₂ / aluminum₂ O₃ There must be a molar ratio within the limits of 5.3-6.85.

[0010] There is an alkali metal oxide as a fundamental component of glass. By combining effectively the clarifier mentioned later according to this invention, it becomes possible to except Li₂ O thoroughly, and it becomes possible to attain simultaneously the characteristics of the request described in said purpose about the both sides of cellular quality and chemical strengthening with single new glass. There must be a Na₂ O content in 8.5-15.5mol% of within the limits. If a Na₂ O content exceeds 15.5mol %, chemical resistance will fall, if lower than 8.5mol %, on the other hand, it will become difficult to fuse glass in the first place first, and it is Na⁺/K⁺ to the second. The increase in the intensity only by ion exchange will be restricted.

[0011] The component which has an exceptional and surprising operation is K₂ O, and this component needs to exist in% of the amount of 2.5-4.0mol. This component increases the fusion nature of glass and promotes the ion exchange process by K ion in a salt bath of Na ion in glass. Furthermore, homogenization process is also simplified and it also becomes approaching the state of request that a blister is absent. This is for simplifying ****, without spoiling the chemical resistance and chemical-strengthening nature (chemical reserve stress grant nature) where the direction of K₂ O increased the basicity of glass and which were excellent as a result compared with Na₂ O of the number of the said mols. It is only the case of above-mentioned within the limits that same chemical and the glass which has a mechanical property and was

excellent in cellular characteristics can be manufactured easily. Furthermore, the ratio of aluminum₂O₃ / K₂O is also important. aluminum₂O₃ The more inclusion increases, the more a lot of K₂O is needed. Therefore, there must be a molar ratio of aluminum₂O₃ / K₂O within the limits of 2.8-3.6. [a K₂O content / less than / 2.5 mol %] when aluminum₂O₃ / K₂O ratio is less than 2.8 The density of air bubbles and the size of air bubbles increase, and on the other hand, when a K₂O content is larger than 4.0mol % and aluminum₂O₃ / K₂O ratio is larger than 3.6, intensity of glass cannot be enough increased between chemical strengthening treatment (chemical reserve stress grant processing). Two sorts of alkali metal oxides also need to exist by the ratio which balance was able to take mutually. That is, there must be a molar ratio of Na₂O/K₂O within the limits of 3.0-5.6.

[0012] other indispensable components are MgO(s) -- at least 3.0mol % -- it is necessary to exist As a result, the basicity of glass rises and homogenization is promoted. However, under existence of bivalent ion, since Na ion joins together more strongly in aluminosilicate glass, MgO is also checking ion exchange process. For this reason, MgO must not exceed 9.0mol % at the maximum. Other alkali earth metal oxides and ZnO also have the same operation. therefore, glass -- CaO, SrO, BaO, and ZnO -- total amount sigma it is CaO+SrO+BaO+ZnO -- 0-2.5mol % -- it can contain 0.1 to 2.5% preferably. The thing in which MgO is more desirable than other alkali earth metal oxides and ZnO is because there are few degrees which spoil chemical resistance than these oxides, while MgO raises fusion nature like BaO and CaO. Furthermore, it is TiO₂. It is the indispensable component of glass. TiO₂ The content must not exceed 1.5mol% of what needs to be more than 0.5 mol %, and this is because trouble arises between melting of a batch that it is outside this range.

[0013] In order to obtain the best result about the total and size of air bubbles, other components, i.e., clarifier, and clear assistants also need to exist in the combination which balance was able to take. CeO₂ -- the inside of glass -- 0.02-0.5mol % -- it is necessary to exist CeO₂ It not only has a **** function, but it gives the absorptivity of ultraviolet rays with many medicine top problems high enough to glass. Therefore, the activity of the glass in the Lighting Sub-Division industry is also attained. The required amount of a clarifier is aluminum₂O₃ which exists in glass. Being influenced by the amount was found out. aluminum₂O₃ which exists in glass The required amount of a clarifier increases, so that there are many amounts. It is necessary to make it the molar ratio of aluminum₂O₃ /(CeO₂+TiO₂) specifically become within the limits of 7.6-18.5. As₂O₃ You have to exist in% of the amount of 0.02-0.35mol. SnO₂ It is effective in defecation similarly and can exist in the amount not more than 1.0 mol %.

[0014] Glass is F₂ of% of the amount of 0.05-2.6mol further. It is necessary to contain. As for the minimum of this range, cellular quality is required-upper-set up and a maximum is set up in view of the above-mentioned operation of the fluoride to the network structure of glass. The glass of the above-mentioned composition is processible by the conventional drawing-out method, for example. For the cellular high quality and good consolidation nature (reserve stress grant nature), it is dramatically suitable for manufacture of the tempered glass board for data-hold media, or consolidation safety glass.

[0015] As₂O₃ When not added, new glass can also be processed with float glass equipment again. This

type that is specified to Claim 3 of arsenic non-containing glass is TiO_2 of the amount described above in order to attain desired cellular high quality. And CeO_2 In addition, 0.02-1.0mol% of SnO_2 And 0.5-2.6mol% of F2 It contains. That is, it is necessary to make the minimum content of a fluoride high and, and is SnO_2 compared with arsenic inclusion glass. It becomes an essential ingredient. The cellular quality in which arsenic inclusion glass is remarkable and this glass was excellent can be attained, has very good cellular quality similarly [there is nothing, however], about the number of the air bubbles of the class of the big diameter especially described above, is good, therefore dramatically suitable for manufacture of consolidation safety glass.

[0016] It is made for composition of new glass to have chemical strengthening (reserve stress grant) which is powerful and has endurance in glass simply built by chemical strengthening treatment. For that, glass contains 100 weight % - 90weight % or more of potassium salt, for example, potassium nitrate, and immerses in a salt bath usual [of as / whose degree of bath temperature is 350-550 degrees C] over 0.5 to 20 hours. The salt bath can contain other components which lower the melting point. By such processing, thickness is about 14 micrometers to 230 micrometers or more, and flexural strength is 350-900Ns/mm². A compressive stress band generates. Prolonged immersion time is needed, so that temperature is low in that case. All things the anion is stable in the above-mentioned temperature span can be used for a salt bath with common potassium salt. A potassium content reduces a salt bath (it usually starts from 100% of potassium salt) for ion exchange, and when the desired ion exchange depth is no longer obtained, they are exchanged. It is usually a time of potassium salt becoming 90 weight % to become such a situation. It is also possible to start, where it used 10 or less weight % of other salt and the melting point of a bath is lowered from the beginning. Of course, this means that the ion exchange capability of a bath is exhausted the part earliness.

[0017]

[Effect of the Invention] Chemical strengthening (chemical reserve stress grant) can be carried out easily, and it has high bending strength after chemical strengthening, and the total of air bubbles has quality high about the point that it is few and the size is also small, and there is an advantage of the new glass of this invention in possessing combining these characteristics. Probably, other effects and advantages of this invention will be clear from the description mentioned above and the following work examples.

[0018]

[Example] Table 1 shows some examples of the new glass of this invention which carried out chemical strengthening treatment (chemical reserve stress grant processing), and is those composition and KNO_3 . Many characteristics relevant to the ion exchange conditions, the cellular quality, and intensity of a under [a bath] are shown.

[0019] Glass was manufactured from the usual raw material in the platinum crucible containing 4l. The raw material was supplied over 8 hours with the melting temperature of 1,580 degrees C. After holding glass to this temperature over 14 hours after that, it cooled to 1,400 degrees C over 8 hours, agitating, and it was poured out in the mold of the graphite which carried out remaining heat to 500 degrees C. In order to

conduct a preliminary visual inspection, this cast block was processed into the cube which ground the surface. The glass board which the circular glass board which has the form and the size of a hard disk substrate, i.e., an outer diameter, opened from this glass article to 65.0mm by the usual method, and the pore 20.0mm in diameter opened in the center at 0.635mm in thickness was manufactured. It is KNO₃ to this glass board ground and ground precisely. Chemical strengthening treatment was performed under the monograph affair shown in the table in the bath.

[0020] New glass can also be manufactured in the solution tank which could manufacture on the output scale all over the platinum trough, or was lined as another method by ceramics (aluminum zirconic acid-ized silicon system ceramics), for example, AZS brick. The total of the air bubbles of glass changes as a function of fusion capacity so that it may be well-known. Usually, it will be improved if capacity is increased. Therefore, the glass of the work example 3 of Table 1 is fusion capacity >1m³ again. It was manufactured on the output scale and had at most two small air bubbles (ϕ = 1-20 micrometers) per 1l. of vitreous humour products, and two large air bubbles (ϕ = 80-150 micrometers). The claim about other above mentioned characteristics was also filled.

[0021] Each characteristics shown all over Table 1 are measured by the following methods. Bending strength is measured by the method of the following usually used in glass industry, and aims at the load produced in a actual activity. What was done is what is called a double ring examination, and it is by this examination, A diameter lays on the metal support ring which has the annular cutter of hardening steel in the chemical-strengthening-treatment glass board for which it has the form and the size of a hard disk substrate whose diameter is somewhat smaller than 60mm (ϕ = 65mm), i.e., the glass board for an examination, and doubles a center. On this glass board, another metal support ring which has a steel cutter is laid similarly, and a center is doubled. A diameter is 25mm and this cutter has a diameter somewhat larger a little than the pore (ϕ = 20mm) of the center of a hard disk substrate. The force in which the cutter of the ring by the side of besides pushes the glass board laid on the cutter of a lower ring the speed for 2mm/, therefore continues increasing with constant speed to a hard disk substrate will be added. Let load in the time of a substrate fracturing be bending strength (N/mm²). In this examination, load regards it as acceptance, when fracture arises for the first time exceeding 100N.

[0022] Compressive stress is measured by a stress-optical method. That is, when compressive stress is added to the glass plate, change arises in the refractive index of a parallel and vertical direction to the stress direction, and a glass plate comes to show birefringence. Birefringence, i.e., the difference of these refractive indices, is proportional to the added stress according to the stress-optical coefficient of the glass concerned, and it is measured from the optical path difference after the reflection in respect of the glass of a vertical and parallel polarization light.

[0023] The thickness of a compressive stress band is measured as follows. A glass sample is observed on the wavelength of 546nm with a polarization microscope. As for the sample to which ion exchange was performed, from the Reasons of a balance, compressive stress is added to all the surfaces, it pulled inside and stress is added. In order to measure stress, a sample is placed between two polarizers made to cross.

The stress added to the sample produces brightness in stress double refraction, therefore the optical path of a microscope. It pulls and the changes (zero-order neutral band) to compressive stress from stress are visible clearly as a dark-colored broadcloth strap under a microscope. The distance from a sample end to a zero-order band serves as measured value of the thickness of a compressive stress band. Since the above-mentioned glass board was too thin for performing this measurement, it used the 2-mm-thick glass piece [in 6mm x 50mm] manufactured and hardened on the same conditions as this glass board for this measurement.

[0024] The size and the total of air bubbles of glass are determined as follows. Big air bubbles ($\phi \geq 80$ micrometers), i.e., the thing which is visible with the naked eye, are counted about the glass cube of 10cm of arm length with the naked eye. The small size and the small number of air bubbles are the glass plate of the 10cmx10cmx0.1cm size which carried out optical polish good, and are measured under the microscope of one 400 to 500 times the magnification of this. The maximum size of the piece of crushing is DIN. Following [and] 1249 and PERT 12, Knoop hardness is DIN. It measures according to 52333.

[0025]

[Table 1]

ガラスの組成（モル％、酸化物基準）及びその本質的特性							
実施例No.	1	2	3	4	5	6	7
SiO ₂	65.54	67.32	63.60	63.67	66.26	66.83	67.36
Al ₂ O ₃	9.60	11.18	11.91	9.74	10.91	10.91	11.28
Na ₂ O	8.66	13.58	12.49	16.02	11.30	11.30	12.82
K ₂ O	2.68	3.17	3.48	2.89	3.82	3.82	3.82
MgO	8.62	3.29	6.51	3.97	3.25	3.25	3.25
CaO + SrO + BaO + ZnO	1.25	0.24	0.47	0.14	0.12	0.12	0.24
SnO ₂	1.0	—	—	0.15	—	—	0.15
TiO ₂	1.19	0.54	0.66	0.64	1.23	0.56	0.54
CeO ₂	0.06	0.46	0.02	0.15	0.19	0.19	0.15
F ₂	1.41	0.09	0.51	2.53	2.59	2.59	0.22
As ₂ O ₃	—	0.17	0.35	0.06	0.33	0.33	0.17
交換温度 (°C)	500	450	400	450	480	480	520
交換時間 (時間)	10	1.5	5	4	6	6	20
圧縮応力帯域の厚さ (μm)	105	35	45	52	128	125	220
最大破砕片サイズ (mm)	7	3	4	7.5	6	5.5	2.2
曲げ強さ (N/mm ²)	720	490	410	560	640	620	900
ヌブ 硬度 (KH)	585	590	600	545	562	568	609
弾性率E (kN/mm ²)	70	71	72	66	68	68	72
熱膨張係数 $\alpha_{20/300}$ (10 ⁻⁶ /K)	8.2	8.9	9.1	9.6	9.1	9.1	8.9
ガラス 遷移温度T _g	595	632	618	565	573	579	626
ガラス の体積1 リットル当りの $\phi 1 \sim 20 \mu m$ の気泡の数	245	28	31	82	45	63	35
ガラス の体積1 リットル当りの $\phi 80 \sim 150 \mu m$ の気泡の数	8	3	3	9	4	5	5

[0026] Table 2 leaves basic glass (work example 3 of Table 1), and shows the effect exerted on the total and size of air bubbles when changing a clear assistant and a clarifier. The rate of the remaining components which are not shown in a table presupposes that it is fixed, and is SiO₂. Only the content is changed. This is every SiO₂ in order to correct them, since the total quantities of the changed clarifier content differ. A content is used. L1 and L2 are CeO₂. It is a non-containing comparative example. L10 is As₂O₃. It is the comparative example which shows a fluoride content [required in non-containing glass] high in comparison.

[0027]

[Table 2]

	L 1	L 2	L 3	L 4	L 5	L 6	L 7	L 8	L 9	L10
CeO ₂	—	—	0.04	0.04	0.04	0.08	0.11	0.11	0.12	0.11
F ₂	—	0.51	0.09	0.51	1.04	0.51	0.51	2.57	1.08	0.50
As ₂ O ₃	0.33	0.33	0.33	0.17	0.33	0.17	0.17	—	—	—
SnO ₂	—	—	—	—	—	—	—	0.22	0.22	0.04
気泡 (φ = 1~20 μ m)	210	195	87	55	130	25	30	540	320	705
気泡 (φ = 80~150 μ m)	39	15	5	4	18	0	2	1	11	28

It already explained that a fluoride content could promote the stress relaxation in chemically strengthened glass. O₂ in melting glass Partial pressure also has a bad influence fluorine have. This is ZrO₂ which doped yttrium. It can measure using the oxygen probe produced from ceramics. The glass which has new composition of this invention in a surprising thing is sufficient O₂ in melt irrespective of fluoride content. It has both remarkable slight stress relaxation after partial pressure and a consolidation, and it was found out that this stress relaxation can be detected now only in high temperature after prolonged progress.

[0028] The following work examples are for showing low stress relaxation essential to this invention. It is a glass plate with a thickness of 0.635mm which has composition of the work example 7 shown in Table 1 KNO₃ [520-degree C] 20 time processings were carried out in the bath. 220 micrometers in thickness, compressive stress of 800Ns/mm² The compressive stress band was formed. Table 3 shows time until thickness reduction of a compressive stress band is observed at various temperature. The used metering device can detect thickness change from 4 micrometers. The used optical method was already explained. Thickness reduction of such a compressive stress band is connected with relief of compressive stress, and is easier to measure than compressive stress relief itself.

[0029]

[Table 3]

温度 (℃)	時間 (h)
300	>1000
350	500
400	100
500	30

If it extrapolates, by the time stress relaxation arises, 50,000 hours or more will pass at the temperature of 200 degrees C. For example, about a remarkable low temperature below 60 degrees C, it can be considered that compressive stress is substantially held infinitely with a strength property.

[Translation done.]